The Effect of CHOSP on Housing Starts

By: Gordon R. Sparks

1985

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Abstract

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The purpose of this study is to determine the effect of the Canadian Homeownership Stimulation Plan (CHOSP) on construction activity. The program, which provided a grant of $3,000 to buyers of new houses and first-time buyers of existing houses, was in effect over the period July, 1982 to June, 1983 (first-time buyers were eligible until January, 1983). During this period housing starts rose substantially but there was a also a substantial decline in interest rates. A quarterly time series regression model estimated over the period 1965 to 1984 is used to measure the effect of CHOSP after allowing for interest rates and other factors influencing starts.

A stock adjustment model is used to explain the level of single-unit starts and the major determinants of the desired stock per capita are found to be income per capita, mortgage interest rate, inflation rate and dummy variables included to represent CHOSP. The program is found to have a highly significant influence and during the four quarters it was in effect, single-unit starts are estimated to have been about 53 percent higher than would have been the case without CHOSP.

During the year and a half following the termination of the program, starts are estimated to have been about four percent lower as a result of the buildup of the stock during the CHOSP period. The stock adjustment model predicts that within five years there is a reduction in starts that accumulates to one-third of the total number of starts induced by CHOSP during the period it was in effect. Ultimately, there is a complete offset but this occurs very slowly over time.

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The statistical analysis indicates that the major determinants of single-unit housing starts per capita are income per capita, mortgage interest rate, inflation rate, and existing stock. In addition, CHOSP is found to have a very significant effect and during the four quarters the program was in effect, single-unit starts are estimated to have been about 53 percent higher than would have been the case without CHOSP.

During the year and a half following the termination of the program, starts are estimated to have been about four percent lower as a result of CHOSP. The statistical model predicts that within five years there is a reduction in starts that accumulates to one-third of the total number of starts induced by CHOSP during the period it was in effect. Ultimately, there is a complete offset but this occurs very slowly over time.

The statistical analysis used in this study is subject to the usual hazards of the trade. In particular, we cannot be certain that the effects identified with CHOSP were not in fact caused by some other factor not taken into account. Using quarterly data, we have only four periods when the program was in effect and this limits the power of the methods used. Nevertheless, the high degree of statistical significance obtained gives us considerable confidence in the results.

Final Report CR No. 0429-13-3 Mar. 12, 1986

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Introduction

As part of the June, 1982 Budget, the government of Canada introduced the Canadian Homeownership Stimulation Plan (CHOSP). Its purpose was to stimulate residential construction by providing a grant of $3,000 to buyers of new houses and first-time buyers of existing houses. The program was in effect over the period July, 1982 to June, 1983 (first-time buyers were eligible until January, 1983) and some 260,000 grants were disbursed.

In this study we estimate a time series regression model of housing starts using quarterly data for the period 1965 to 1984. We then carry out simulations to determine the quantitative impact on the time path of housing starts. In particular, the following questions are addressed:

(1) Housing starts rose substantially over this period but at the same time there was a substantial decline in interest rates. What was the net effect of CHOSP after taking account of interest rates and other factors determining the level of housing starts?

(2) To what extent did CHOSP and lower interest rates combine to unleash pent-up demand for new housing accumulated during previous periods of high interest rates?

(3) Did CHOSP contribute to instability in starts by bringing forward demand for new housing and reducing starts in subsequent periods?

Outline of the Model Used

The approach used in this study is similar to that followed in the earliest postwar model of Canadian residential construction developed by Oksanen (1966). He used a stock-flow model focussing on the determinants of demand for housing. The desired stock of houses is assumed to depend on income, relative price of housing, and an interest rate. The stock adjustment model is used to explain the volume of housing starts as a function of the gap between the desired and actual stocks. More recently this approach has been used by Smith (1969a, 1969b, 1970) who also develops separate equations for single-unit and multiple-unit starts. Similar models are included in a number of macro econometric models of the Canadian economy. A survey of the housing sectors of these models has been provided by Foote (1985).

A number of recent studies of construction activity in the United States have focussed on the on the impact of inflation. Poterba (1984) and Summers (1981) analyse the demand for housing as an investment and argue that expectations of future inflation increase demand in relation to other assets since capital gains on housing are not subject to personal income tax. On the other hand, Kearl (1979) and Summers (1981) argue that inflation may create a bias against housing. In a period of high inflation the stream of real payments under a constant payment mortgage

contract is tilted so that the borrower faces a higher burden in real terms in the earlier years. In the presence of capital market imperfections house buyers may therefore be subject to a cash flow constraint.

In the present study we consider only single detached houses and use the following model to explain starts. First, the desired stock of houses is assumed to be determined by:

$$K^*/N = a_0 + a_1 Y/N + a_2 YP + a_3 P + a_4 R + a_5 RM + a_6 I + a_7 PA + a_8 Q \qquad (1)$$

where the variables are defined as follows (precise definitions and sources are given in Table 1):

K*	desired stock of single unit houses
N	population
Y	real disposable income
YP	permanent real disposable income per capita
P	price of houses relative to consumption good prices
R	index of rents relative to consumption good prices
RM	mortgage interest rate
I	expected rate of increase of house prices
PA	demographic variable
Q	dummy variable for CHOSP

This relationship can be viewed as reflecting the intertemporal choice problem facing a household. Given lifetime resources available as represented by permanent income, the household chooses an optimal time path of consumption of each good including the flow of services from owner-occupied housing. Assuming the flow of services to be proportional to the stock, the desired stock will depend on the price of housing services

Table 1: Variable Definitions and Sources

Variable	Definition	Source
HS	Starts of single-detached units, thousands, seasonally adjusted at annual rates	CMHC, *Canadian Housing Stat.* Stat. Can. 64-002, *Housing Starts and Completions*
N	Population, millions, beginning of quarter	Stat. Can. 91-001, *Quarterly Estimates of Population*; 11-003, *Can. Stat. Rev.*
Y	Disposable income in 1971 dollars, seasonally adjusted at annual rates	Stat. Can. 13-001,13-531, *Nat. Inc. and Exp. Accounts*
PCON	National accounts deflator for consumption (1971=1.00)	"
P	Price of houses divided by PCON 1964-75: new house component of Consumer Price Index (1976=100) 1976-84: new housing price index (1976=100)	Stat. Can. 62-002, *Prices and Price Indexes*; 62-007, *Construction Price Stat.*; 62-010, *Consumer Prices and Price Indexes*
R	Rent index (1971=100) divided by PCON	Stat. Can. 62-002, 62-010
RM	Mortgage rate, percent 1965-76: conventional mortgages 1977-84: rates quoted by institutional lenders	CMHC, *Canadian Housing Stat.*
I	Four quarter change in price of houses, percent	
K	Stock of single-unit houses, thousands of units, beginning of quarter	Census bench marks: *Canada Year Book* Completions: same sources as starts
IUC	Inventory under construction; weighted average of starts lagged one, two and three quarters	
YP	Permanent income per capita, 16 quarter average of Y with linearly declining weights	
P25	Proportion of the population aged 25-34, percent	Stat. Can. 91-512, 91-518, 91-520
P35	Proportion aged 35-44	"
Q	Dummy variable for CHOSP, equals one for 1982,3Q to 1983,2Q	
QT	Q times time trend scaled so as to have mean zero over the CHOSP period (values: -1.5,-.5,.5,1.5)	
QR	Q times deviation of RM from its mean over the CHOSP period	

relative to rents and the price of other consumption goods. The price of housing services in turn depends on the price of houses and the real interest rate.

The real interest rate is represented here by the mortgage interest rate minus the expected rate of increase of house prices. In view of the above discussion of the impact of inflation, these two variables are entered separately to allow for an additional influence of the inflation rate. The existence of cash flow constraints also suggests that current as well as permanent income will have an effect.

Assuming the volume of housing starts per capita to be proportional to the gap between the desired stock and the actual stock at the beginning of the period (K):

$$HS/N = b(K^*/N - K/N) \qquad (2)$$

Substituting (1) into (2) we obtain the equation to be estimated in the form:

$$HS/N = ba_0 + ba_1 Y/N + ba_2 YP + ba_3 P + ba_4 R + ba_5 RM + ba_6 I + ba_7 PA + ba_8 Q - bK \qquad (3)$$

The stock of single-unit houses is estimated by using completions to interpolate between census year bench marks. Removals are spread evenly over each five-year intercensal period.

Regression Results

Table 2 shows the regression results using quarterly data for the period 1965-1984. Based on the statistical significance of the coefficients, the following equation (#2 in the table) was selected for simulation analysis (absolute values of the t-

statistics are shown in parentheses):

$$HS/N = 11.14 + 2.70Y/N - .301RM + .148I - .076K/N \quad (4)$$
$$(4.97) \quad (10.7) \quad (7.15) \quad (7.10) \quad (-3.72)$$
$$+ 1.92Q + .529QT$$
$$(5.80) \quad (2.15)$$
$$R^2 = .80 \qquad DW = 1.57$$

Current income enters the equation with a highly significant coefficient but permanent income did not (see Table 2, #9). The coefficient of 2.70 implies an elasticity of 2.1. This value is obtained by multiplying by the ratio of the mean of Y/N to the mean of HS/N as follows:

income elasticity of starts = 2.70 (3.30/4.27) = 2.1

To obtain the income elasticity of the stock, we solve for a1 in equation (3) using the estimated coefficients on income and the lagged stock:

a1 = 2.70/.076 = 35.5

Multiplying by the ratio of the mean of Y/N to the mean of K/N, we obtain:

stock income elasticity = 35.5 (3.30/175.6) = .67

These elasticity values are quite similar to those obtained in other studies. For example Oksanen (1966. p. 313) reports current income elasticities of 1.90 and .5 for starts and the housing stock respectively. For the U.S., Carliner (1973) concludes that the income elasticity of the stock demand is in the range of .6 to .7 for owner-occupied housing.

By rearranging the coefficients on the mortgage rate and the inflation rate, we can exhibit the effect of the real interest rate and the net additional effect of the rate of inflation:

Table 2: Regression Results[a]

1965 Q1 - 1984 Q4

Eqtn.	Y/N	RM	I	K/N	Q	QT	QR	P25	P35	$\bar{R}^2$
1	2.65	-.335	.158	-.066	1.99					.79
	(10.2)	(8.37)	(7.57)	(3.78)	(5.90)					
2	2.70	-.301	.148	-.076	1.92	.529				.80
	(10.7)	(7.15)	(7.10)	(4.31)	(5.80)	(2.15)				
3	2.80	-.273	.138	-.086	1.79	.605				ρ =.23
	(8.73)	(5.54)	(5.71)	(4.03)	(4.93)	(2.47)				
4	2.69	-.305	.150	-.075	1.93		-.205			.80
	(10.5)	(7.14)	(7.12)	(4.18)	(5.78)		(1.79)			
5	2.60	-.325	.164	-.103	1.98			.247	.221	.79
	(2.44)	(7.88)	(7.59)	(2.95)	(5.71)			(.60)	(.92)	
						P	R	IUC	YP	
6	2.68	-.335	.159	-.068	1.99	-.002				.79
	(4.03)	(8.29)	(6.33)	(1.83)	(5.72)	(.06)				
7	2.76	-.333	.159	-.069	2.00	-.004	.003			.78
	(2.29)	(7.49)	(6.25)	(1.69)	(5.50)	(.10)	(.08)			
8[b]	2.40	-.309	.145	-.060	1.99	-.002		.211		.79
	(3.16)	(6.44)	(4.98)	(1.53)	(5.63)	(.08)		(.94)		
9	3.92	-.326	.147	-.056	2.07	.001			-1.47	.79
	(3.04)	(7.97)	(5.39)	(1.47)	(5.84)	(.04)			(1.12)	

[a] Absolute values of the t-statistics are shown in parentheses.

[b] Data period begins in 1965,Q4.

$$-.301RM + .148I = -.301(RM-I) + (.148-.301)I$$
$$= -.301(RM-I) - .153I$$

Thus inflation has a negative net influence so that the capital gains effect is outweighed by the cash flow effect.

The coefficient of the lagged stock implies a somewhat slow speed of adjustment. Since the flow of starts is measured at annual rates, the quarterly adjustment coefficient is .076/4=.019. This implies that it takes nine years to remove half the gap between the desired and actual stocks.

The coefficient on the CHOSP dummy implies that the program had a very substantial and statistically significant impact. The second CHOSP variable, QT, is obtained as the product of Q and a time trend scaled so that its mean is zero over the CHOSP period. This variable is introduced as a result of the pattern of residuals obtained when only the dummy variable Q is used (see #1 in Table 2). During the period that the program was in effect there was a steady increase in housing starts which is not explained by the variables used. We thus get a slightly better explanation of the period by including the time trend.

Equation #4 in Table 2 shows the effect of substituting an interaction of Q with the mortgage interest rate (entered as a deviation from its mean). The negative sign reflects the fact that interest rates were falling during the CHOSP period and this provided an additional stimulus to starts. The difference between equations #2 and #4 is quite small and we return to the question of choosing between them in the next section.

The remaining equations in Table 2 show the results of experimenting with a number of other variables. In the third

equation, allowance is made for the possibility of first order serial correlation in the error term. The autoregressive parameter is estimated to be .23 and the effects of this transformation on the coefficients and their standard errors is fairly minor. In general, in none of the equations shown in the Table is there clear evidence of a serial correlation problem with the Durbin-Watson statistics all in the range 1.57 to 1.66. This puts them in the inconclusive range of the Durbin-Watson test.

In Equation #5, two demographic variables are added but neither enters significantly. P25 is the percentage of the population in the age group 25 to 34, while P35 is the percentage aged 35 to 44. The last four equations include the relative price of houses with an insignificant coefficient. Similarly, the rent index (#7) and permanent income (#9) fail to add any explanatory power. The latter variable is represented by a 16 quarter average of current and lagged per capita disposable income with linearly declining weights.

Inventory under construction is included in equation #7 as a supply variable. It is measured by a weighted sum of starts over the preceding three quarters. The weights (.34, .17 and .07) are estimated from the coefficients of a regression of completions on starts. Given the demand for housing as represented by the gap between the desired and actual stocks, we would expect the flow of new starts to be negatively related to the inventory under construction. However this variable does not enter the equation with a significant coefficient.

Static Simulation

To derive the implications of our statistical model for the effect of CHOSP on the time path of housing starts, we first consider a decomposition of housing starts into the contribution of the CHOSP dummy variables compared with the other explanatory variables. This decomposition based on Equation #2 of Table 2 is shown in Table 3 and Figure 1. The first column of the Table shows actual housing starts (starts per thousand persons at annual rates) and the second column gives the contribution of the mortgage rate as obtained by multiplying the regression coefficient by the observations on the rate. The large negative contribution of the mortgage rate in the first half of 1982 reflects the high level of rates at that time. Subsequently rates fell providing some stimulus to housing starts.

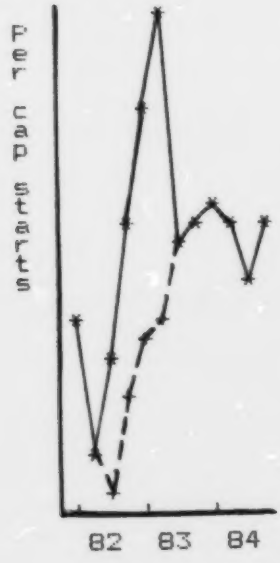
Adding up the contributions of the mortgage rate, other variables (excluding CHOSP dummies) and the error term we obtain the hypothetical level of starts that would have occurred in the absence of the CHOSP program. This variable is plotted in Figure 1. The last three columns show the effect of CHOSP obtained by combining the two dummy variables. In the units of the dependent variable the effect rises from 1.13 to 2.71 over the four quarters of the program. In terms of the change in starts from 1982,Q2 to 1983,Q2, CHOSP accounted for 2.71 compared with the mortgage rate contribution of 1.95.

As a percentage of starts the effect of CHOSP is in the range of 51 to 56 percent while in terms of units the effect rises

Table 3: Static Simulation

		Per Cap	Contribution of:			CHOSP		
Yr.	Q.	HS	RM	Other	Error	Per Cap	Percent	Units
1982	1	1.88	-5.62	7.92	-.42	0	0	0
	2	1.75	-5.73	6.89	.59	0	0	0
	3	2.03	-5.63	6.43	.10	1.13	56%	28
	4	3.24	-4.51	6.12	-.02	1.65	51%	41
1983	1	4.04	-3.90	6.01	-.25	2.18	54%	54
	2	5.27	-3.78	6.16	.18	2.71	51%	67
	3	3.41	-3.88	6.90	.39	0	0	0
	4	3.32	-3.68	6.82	.18	0	0	0
82 2 - 83 2		3.52	1.95	-.73	-.41	2.71		

Figure 1: Actual and Simulated Housing Starts



from 28 thousand to 67 thousand (seasonally adjusted at annual rates). The coefficient on Q of 1.92 is the estimated average effect over the four quarters. Given a standard error of .33 we have a two-standard error confidence interval (about 95%) of 1.26 to 2.58. In terms of percentages this translates into the interval of 35% to 71% centred on 53%.

As mentioned above, Equation #4 of Table 2 provides a different interpretation of the time path of starts during the CHOSP program. Here the trend component is attributed to an interaction of the program with declining interest rates. The previous period of high interest rates created a pent-up demand which was released by the combination of falling interest rates and the subsidy. This interpretation would have very little effect on the calculations shown in Table 3 since the time path of the interest rate is highly (negatively) correlated with a time trend. The observations for QT are -.5, -1.5, .5 and 1.5, while for QR (deviations of the mortgage rate from its mean of 14.81) we have 3.90, .19, -1.84 and -2.25. Using the coefficients of 1.93 and -.205 from Equation #4, the effect of CHOSP becomes 1.13, 1.89, 2.31 and 2.39 for the four quarters of the program. The average effect of 1.93 is virtually identical to the value of 1.92 obtained from Equation #2.

On the other hand, the choice between these two equations would make a considerable difference if the analysis were used to measure what the effect of CHOSP would have been if there had not been a decline in interest rates. For example, if the mortgage rate had remained at the level of 18.71 observed in the first quarter of the program, the value of QR would have

remained at 3.90 and the effect of CHOSP would have been 1.13 for all four quarters of the program. In any event, the data used in this study does not provide any basis for a clear discrimination between the two hypotheses.

Dynamic Simulation

The simulation results reported above do not take into account the negative feedback effect operating through the lagged stock of houses. A higher level of starts today means a lower level tomorrow when the units are completed and added to the existing stock. To measure this effect we first obtained the weights which translate starts into completions. Using data for the period 1978 to 1984, a regression yielded the following relationship:

$$\text{Completions} = .19\ \text{Starts} + .47\ \text{Starts}(-1) + .17\ \text{Starts}(-2) + .10\ \text{Starts}(-3) + .07\ \text{Starts}(-4)$$

The effect of allowing for this feedback is shown in Table 4. As can be seen by a comparison with Table 3, the figures for the four quarters of the program are little changed. This reflects the lag in the feedback and the low estimated speed of adjustment. Going beyond the second quarter of 1983, we see that there is some offset to the higher level of starts during the program period. By the beginning of the third quarter of 1983, the model implies a buildup of the stock by 4.35 (dwelling units per thousand persons) and given a speed of adjustment of .019 per quarter, this reduces starts by .019(4.35) = .08.

Because of the slow speed of adjustment, this offset is not large. However, if we continue the simulation further out, we

Table 4: Dynamic Simulation

		Per Cap	CHOSP		
Yr.	Q.	HS	Per Cap	Percent	Units
1982	1	1.88	0	0	0
	2	1.75	0	0	0
	3	2.03	1.13	56%	28
	4	3.24	1.65	51%	41
1983	1	4.04	2.16	53%	53
	2	5.27	2.66	50%	66
	3	3.41	-.08	-2.3%	-2.0
	4	3.32	-.12	-3.6%	-3.0
1984	1	3.20	-.13	-4.1%	-3.3
	2	3.19	-.14	-4.4%	-3.5
	3	3.70	-.14	-3.8%	-3.5
	4	3.17	-.14	-4.4%	-3.5

find that one-third of the total effect on starts over the CHOSP period has been offset within five years and one-half has been offset within nine years. The structure of the model implies, of course, that ultimately there will be a complete offset. The program induced a temporary rise in the desired stock that stimulated starts in the short run, but in the long run the desired stock will return to its initial level.

This is exactly what one would expect. A temporary subsidy to house buyers cannot have a permanent effect on the stock of houses since in the long run the subsidy can be transferred to other assets through sale of the house. As our figures suggest it may well take a long time for this process to work itself out. On the other hand, this long-run adjustment has little relevance for policies designed to mitigate the effects of business cycles. Our results indicate that on termination of the program there was an offsetting loss of starts of about four percent over the following year and a half. Thereafter the long-run adjustment process continues with a diminishing effect on starts.

Conclusions

The major conclusions of this study are as follows:

1. Using a time series regression model the major determinants of single-unit housing starts per capita were found to be income per capita, mortgage interest rate, inflation rate, existing stock, and the CHOSP program.

2. Over the period July, 1982 to June, 1983 when the program was in effect, falling interest rates provided a stimulus to

construction, but after allowing for this and other factors, the program had a significant effect. Our model indicates that during the four quarters of the program, starts were about 53 percent higher than would have been the case without CHOSP.

3. The combination of lower interest rates and CHOSP unleashed pent-up demand in the sense that it led to a rise in the desired stock of housing as compared with the period of high interest rates that preceded the introduction of the program. This in turn gave rise to a substantial increase in construction activity. It is possible that there was pent-up demand arising from the inability of house buyers to meet the down payment requirements of mortgage lenders and that CHOSP combined with lower interest rates removed this constraint on demand. The model used in this study does not provide any evidence on this question.

4. During the year and a half following the termination of the program, starts were about four percent lower as a result of CHOSP. Within five years, there is a reduction in starts that accumulates to one-third of the total number of starts induced by CHOSP during the period it was in effect. Our analysis implies that ultimately there will be a complete offset, but this occurs slowly over time.

5. The statistical analysis used in this study is subject to the usual hazards of the trade. In particular, we cannot be certain that the effects identified with CHOSP were not in fact caused by some other factor not taken into account. Using quarterly data, we have only four periods when the program was in effect and this limits the power of the methods used.

Nevertheless, the high degree of statistical significance obtained give us considerable confidence in our results.

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